association fibres. The second great division of the brain has no direct connection whatever with the corona radiata, but contains only association fibres. For sake of brevity Flechsig designates the first class of areas as sensory centres, "Sinnescentren," and they include the optic area around the calcarine fissure, the auditory area in the posterior part of the first temporal convolution, the olfactory area in the hippocampal gyrus and the posterior part of the inferior surface of the frontal lobe, and last the great central motor region about the fissure of Rolando, including the posterior portions of the frontal convolutions.

The second great class of areas, the association centres, "Associationscentren," occupy the four great tracts, terra incognita, not accounted for by the localizationalists. These are the anterior portion of the frontal lobe, the island, a large part of the temporal lobe, and a large region in the parieto-occipital lobe, including præcuneus and the posterior portion of the parietal lobe. The extent of these areas can best be determined in the brain of a three-months old child. At this age almost the entire corrona radiata is medulated, and these streams of medulated fibres spray out to distribute themselves solely in the sensory centres above described. Scarcely one-third of the cortex is thus supplied with medulated nerve fibres, and the large association areas comprising more than two-thirds of the entire brain surface are either entirely destitute of medulated fibres or contain only a few scattering fibres which come to them, for the most part, from the sensory centres. It would thus seem at this stage of development each sensory centre possessed its own sensory mechanism distinct from every other. Later, at what age it is not stated, each association centre develops association fibers which unite it with two or more sensory centres, and these fibers are much more numerous than fibers of association which unite sensory with sensory centres. The greatest difference, according to Professor Flechsig, between the brain of man and that of other animals is found in the enormous development of the association centres. Their development, in fact, determines the type of brain and the form of the skull.

*Beitrag zur Lehre von der absteigenden Degeneration in Gehirn und Rückenmark und Bemerkungen über die Localization und die Leitungsbahnen der krämpfe bei der "Absynth-Epilepsie,"* ROBERT BOYCE. Neurologisches Centralblatt, Bd. XIII, p. 466, 5 figs.

Boyce has carried out a long series of experiments upon cats to determine first, the exact descending degenerations connected with the different operations, and, second, the locus, or loci, of origin for the convulsions in, "absynth-epilepsie." The following observations were made: 1. Extirpation of motor areas of one side. This is followed by degeneration of the corresponding pyramid, no other tract being implicated in the least. 2. Extirpation of one hemisphere, or, what amounts to the same thing, hemisection of the mid-brain. After this operation degeneration occurred in the descending root of the fifth nerve, in the posterior longitudinal bundle, both on the same side, and Meynert's and Forel's bundles of the opposite side. These degenerations were studied by Marchi's method and are made very clear by a well selected series of drawings.

Either directly after the operation, or after the animal had recovered, absynth was injected and a record was obtained upon the myograph from the extensor musles of both fore legs. Asymetrical epileptiform cramps were found to occur. If contractions had been wholly absent from the side corresponding to extirparion of the motor areas, this would have proved that these areas are the sole loci of origin for the convulsions. It was found, however, that centres exist in the medula and cerebellum which are capable of originating epileptiform cramps of the typical clonic character. The rhythm is, however, much slower than

upon the uninjured side. Hemisection of the cervical cord stops all contractions upon the operated side, which proves that it is not possible to stimulate the cord in this way. In this connection it will be remembered that Goltz notes the occurrence of epilepsy in dogs from which the cerebrum has been removed, and this without the use of absynth. The most valuable result of Boyce's experiments lies in demonstration of the fact that epilepsy may be looked upon as a reaction of certain centres in the brain to a poison which may pervade the whole system. Its maximal affect is produced, when the cerebral cortex is intact; but centres in the medulla and cerebellum are sufficiently sensitive to be affected. Many cases of epilepsy in man are doubtless due to similar sorts of intoxications, and the fact that the convulsions begin in centres of irritation, *i. e.*, foci of highest sensitiveness, is further support for the generally accepted views. It would seem reasonable, however, that treatment should begin with the toxic substances in the blood rather than with extirpation of sensitive parts of the brain.

*A Microscopical Study of the Nerve Cell during Electrical Stimulation.* C. F. HODGE. Journal of Morphology, Vol. IX, pp. 449-463, 5 Figs. Boston, 1894.

*Changes in Ganglion Cells from Birth to Senile Death ; Man and Honey-Bee.* C. F. HODGE. Journal of Physiology, Vol. XVII, pp. 129-135, Plate IV. Cambridge, 1894.

*Die Nervenzelle bei der Geburt und beim Tode an Alterschwäche.* C. F. HODGE. Anatomischer Anzeiger, Band IX, Su. 706-710, 4 Figs.

The first of the above papers forms a new chapter in the nerve-cell-fatigue-work, reports of which have been given in this JOURNAL since 1889. By means of specially devised apparatus the spinal or sympathetic ganglion cells taken from the same frog were kept for different lengths of time in a gentle stream of salt solution upon the stages of two similar microscopes. Comparable cells were sought out in each preparation and electrical stimulation was then applied to the one and not to the other, and drawings, by means of the camera lucida, as well as careful measurements, were made of both preparations at regular intervals. Thirty-three experiments were made in all with the fairly uniform result that the nucleus could be seen to gradually shrink in the cells to which stimulation was applied. This decrease in size may amount to as much as 58% in twenty minutes but never exceeded a loss of 75%. The cell as a whole did not shrink perceptibly, but after treating with osmic acid the stimulated cells could be seen to be pervaded by irregular light spaces, representing probably the vacuoles figured and described in former papers. The greatest shrinkage of the nucleus observed in the control cells was 19%. Experiment 3 continued for six days, during the whole of which time it was possible to distinguish nuclei, nucleoli and the granulation of the cell-protoplasm. Active changes however, in the nucleus ceased to be discernable after six hours. Curves of nerve-cell fatigue obtained by plotting the shrinkage of nuclei differ somewhat from the curves which were formerly derived from cells while in the body. In the latter case the nuclei shrank rapidly at first, then very slowly, or gained a little, and finally decreased in size quite rapidly again to a condition of apparent complete fatigue. When the cells are removed from the body and placed in a non-nutrient solution, as might be expected, no such intermediate recovery occurs. Thus curves derived from measurements of nuclei during stimulation show a much more rapid decline than in case of cells in contact with their normal nutritive supply in the body. They come, in fact, to closely resemble fatigue curves for an excited musle. With a stream of saline solu-